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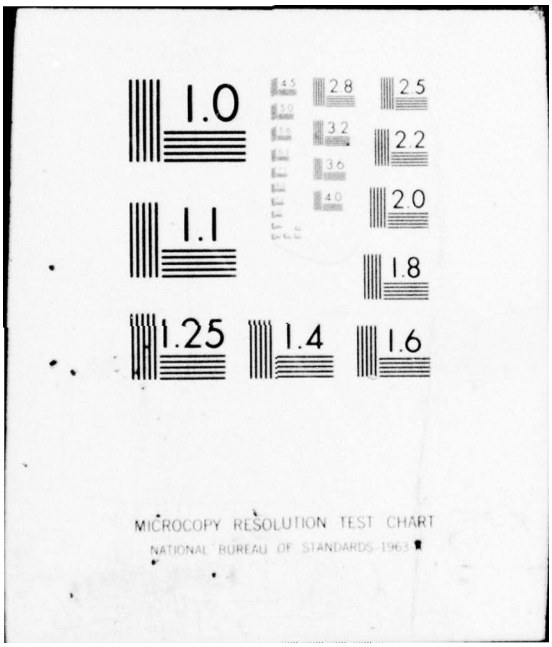
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Report Number 2

MEDICAL ENTOMOLOGY PROJECT

ANNUAL REPORT

E. L. Peyton
September 1, 1976

For the period June 1, 1975 to June 30, 1976

Supported by
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Medical Entomology Project (MEP), a cooperative venture between the Smithsonian Institution and the U.S. Army Medical Research and Development Command, conducts biosystematic research on arthropods of medical importance to the Army. MEP fulfills this requirement by performing biosystematic studies on important groups of vectors such as New World anopheline mosquitoes and *Culex* species involved in virus transmission, providing information on potential vectors for the guidance of

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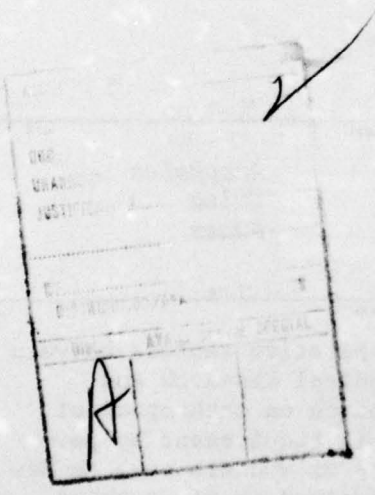
20. Abstract. (Continued)

military field research teams and other governmental agencies, training military entomologists in biosystematic procedures and preparing monographs and technical papers which summarize data on the ecology, taxonomy and medical importance of arthropod vectors in various regions of the world. In addition, MEP performs curation and research on the national collection of mosquitoes at the National Museum of Natural History, Smithsonian Institution.

Two monographs were published during the year (subgenus *Anopheles* of Thailand and subgenera *Indusius* and *Edwardsaedes* of genus *Aedes*) while a third major contribution on the subgenus *Culex* of the Oriental region was accepted for publication during April 1976. A final draft of the subgenus *Rhinoskusea* of the genus *Aedes* was completed. These four publications will total 688 pages, including 201 full page plates of illustrations. Drafts of the following monographs have been completed and are currently being reviewed: subgenus *Lophoceraomyia* of genus *Culex* of the Oriental region, genus *Uranotaenia* of Southeast Asia and *w-albus* and *edwardsi* species groups of the subgenus *Stegomyia* of *Aedes*.

The project arranged for the transfer of a portion of the John N. Belkin mosquito collection to the U. S. National Museum. This increment of the Belkin collection contains 66,754 adults, 7,622 vials of alcoholic material and 32,082 slides from the Old World (primarily the South Pacific) and certain segments of the Mosquitoes of Middle America collection.

Research was initiated on three groups of anopheline mosquitoes of the New World (*Argyritarsis* and *Tarsimaculatus* Groups of the subgenus *Nyssorhynchus* of *Anopheles* and the *Arribalzagaia* Group of the subgenus *Anopheles*) which contain a majority of the important New World vectors of malaria.



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SUMMARY

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INTRODUCTION

Biosystematic studies which lead to the precise identification of vectors are fundamental to any investigation of epidemiology and to the planning of control or eradication. They enable the vector or vectors to be recognized; their ecology and habits to be studied and information about vectorial capacity, resistance to insecticides, geographic distribution and so on to be passed on to other workers. Many instances of failure to control diseases resulting from vector borne pathogens can be traced to neglect of this aspect of preventive medicine research.

The Medical Entomology Project (MEP) was developed to perform biosystematic research on medically important arthropods to meet the U. S. Army Medical Research and Development Command's requirements for accurate identification of actual or potential vectors of human pathogens throughout the world. Thus, MEP is able to respond to these needs and the resources of the project are used to accomplish these requirements. This research is accomplished by a staff of 20, which includes 7 professional entomologists (Appendix 1).

In addition, MEP provides synoptic collections of specimens for the use of various military entomologists and assists them in biosystematic studies of medically important arthropods. This level of support may range from actual training on a temporary duty assignment to furnishing entomologists with keys, other identification guides and the loan of specialized collecting and rearing equipment which cannot be obtained from other sources. Such support has proven invaluable to all concerned, as the Smithsonian Institution has received extremely worthwhile material from these entomologists.

REVIEW OF PROGRESS FOR THE PERIOD 1 JUNE 1975 TO 30 JUNE 1976

1. Biosystematic Studies on Culicidae

a. Genus *Anopheles*

(1) Subgenus *Anopheles* of the Oriental and Nearctic regions (B. A. Harrison)

The monograph on the subgenus *Anopheles* in Thailand was published during December (Harrison and Scanlon 1975). An abstract for this publication was presented in Report Number 1, Medical Entomology Project (September 1975).

A revision of the *Anopheles (Anopheles) crucians* subgroup in the United States was published in March (Floore, Harrison and Eldridge 1976). In this 109 page publication *An. bradleyi* King, *crucians* Wiedemann and *georgianus* King are taxonomically redefined by morphology, ethology and distribution, and established as the *crucians* subgroup of the *punctipennis* (Say) species group. The study involved the examination of over 1,800 specimens and the preparation of 15 plates of illustrations. This work includes a complete review of the history of the 3 species in the United States. The species descriptions include sections on: type-data synonymy; descriptions of female, male, pupa and larva; distribution; taxonomic discussion; bionomics and medical importance. Keys for the *crucians* subgroup are presented for male genitalia, pupae and 4th stage larvae. Additional keys are presented, in an appendix, to separate this subgroup from the other anophelines in the southeastern United States. The 1st through 4th stage larvae of *bradleyi* and *crucians*, the 4th stage larva of *georgianus* and pupa of *bradleyi* and *georgianus* are completely illustrated for the first time. Tables with the ranges of setal branching are included for the 4th stage larvae and pupae of each species.

(2) Subgenus *Cellia (Myzomyia* series) of the Oriental region (B. A. Harrison)

During the past year considerable work was accomplished on the taxonomy and variation of the *Myzomyia* series of *Anopheles* of Thailand. The *Myzomyia* series is represented in Thailand by *An. aconitus* Dönitz, *culicifacies* Giles, *jeyporiensis candidiensis* Koidzumi, *minimus* Theobald and *pampanai* Büttiker and Beales, of which *aconitus* and *minimus* are confirmed vectors of human malarial parasites. The work accomplished included the examination of characters on adults, larvae and pupae, the construction of keys and 14 penciled illustrations of larvae, pupae and selected adult characters in preparation for inking.

A pupal key, using previously undetected differences, was completed for the 5 Thai species. The *minimus* pupal character quickly separates it from the pupae of the other Oriental species in the series (except for the pupa of *fluviatilis* James, which is poorly known). This pupal character further emphasizes the distinctness of *minimus* from *flavirostris* (Ludlow) from the Philippines and Indonesia, which was elevated to specific status by Baisas (1957).

A number of variations have been recorded from larvae in this series. Among these is the shape of the anterior tergal plate on abdominal segment II. Büttiker and Beales (1959) described this plate on *minimus* as convex posteriorly, and enclosing the posterior tergal plate, while that of *pampani* was concave with the posterior plate separate. This study has revealed that up to 29% of the *minimus* larvae collected and reared from areas in Thailand may have the anterior tergal plate concave posteriorly, with the posterior tergal plate separate. Conversely, several larvae of *pampani* from Thailand had the anterior tergal plate on segment II convex and enclosing the posterior plate. Fortunately, the other characters separating these 2 species are fairly stable, with the position of seta 0 on the abdominal segments the most important.

To date, 2,300 female *minimus*, collected in Thailand as adults or reared from larvae, have been examined for more than 20 variations known to occur on the palpus, proboscis, scutum, wing and tarsi. Approximately 37% (857/2,300) of these females exhibited at least one variation. The frequency of variable specimens ranged from 47% (232/495) of the females reared from larvae to 35% (625/1,805) of the wild-caught females. Progeny were reared with associated immature skins from 266 of the wild-caught females. Approximately 47% (124/266) of these parent females exhibited variations. An analysis of the sibling variations in comparison to those of the female parent is the next anticipated step in the study. Many of the variations being found on *minimus* have been used frequently in past keys to the *minimus* species group. Some of the variations are: a considerable range in palpal banding, from *fluviatilis*-type palpi to the apical 2 segments being entirely pale; a pale ventral patch on the proboscis, such as on *flavirostris* and *varuna* Iyengar; the presence of humeral and presector pale spots on the costa, as usually found on *filipinae* Manalang, *mangyanus* Banks and *pampanai*; the absence of the presector pale spot on the costa, as found on *aconitus*, *fluviatilis* and *varuna*; the presence of 3 pale spots on vein 1A, as usually seen on *aconitus* and *filipinae*; and the presence of pale fringe scales at the apex of vein 1A, as usually seen on *aconitus* and *filipinae*. Some other wing characters showing considerable variation are: Cu fork pale or dark; Cu_1 with 1 or 2 pale spots; R_1 with a pale spot in the preapical dark area;

and the amount of dark scaling on vein R_{4+5}. These last 4 characters are used extensively in keys to the *An. funestus* Giles species group in Africa. Since *funestus* and *minimus* are very closely related, the range of variation occurring in these characters on *minimus* suggests that they need to be re-examined in *funestus* and allies in Africa. *Anopheles funestus* is second only to the *An. gambiae* Giles sibling species complex in importance as a vector of human malaria parasites in Africa.

An examination of 449 reared females of *minimus* (with associated immature skins) from the New Territories of Hong Kong, revealed approximately 41% (183/449) exhibited variations of the same types as found on Thailand females. Since Hong Kong is the type-locality for *minimus* these findings lend credibility to the variations encountered in Thailand *minimus*.

A considerable number of variations have also been detected on *aconitus* females with associated skins. Among these are: proboscis entirely dark or with a small ventral pale patch, as found on *minimus* and *varuna*; base of costa with both humeral and presector pale spots, as usually found on *filipinae, mangyanus* and *pampanai;* vein 1A with the apical half dark scaled, as on *fluviatilis, minimus, pampanai* and *varuna;* and the apical 2 segments of the palpi entirely pale, as on some *minimus*.

The most interesting aspect about the variations found to date on *aconitus* and *minimus* is that they appear to be continuous variations rather than polymorphic, and thus do not appear in set patterns or in particular regions of the species range. Consequently, character combinations occur throughout the species range that mimic characters described for other species. Such combinations are now believed to be responsible for past published records of *filipinae, fluviatilis* and *varuna* in Thailand. The immatures of these species have never been collected in Thailand and the records were based on adults. The same probably applies to recent records for *filipinae* and *mangyanus* (both Philippine species) from Nepal (Pradhan and Brydon 1960; Brydon, Joshi and Pradhan 1961; Wattal 1963). The record of *fluviatilis* from Hong Kong (Edwards 1935) also falls in this category.

(3) Subgenus *Cellia (leucosphyrus* group) of the Oriental region (E. L. Peyton)

A preliminary examination of the portion of the collection of the *Anopheles leucosphyrus* group in the MEP and National Museum of Natural History (USNM) collections was made and an assessment of deficiencies determined. Letters were sent to several MEP collaborators requesting the loan of specimens critical to the study. It is felt that with this additional material, sufficient specimens will be available for the study.

(4) Subgenus *Anopheles* of the Neotropical region (G. K. Bryce)

A revision of the *Arribalzagaia* Group of the subgenus *Anopheles* is in progress. At the present time, 20 species are recognized in this group with the addition of *anchietai* Correa and Ramalho to the 19 species placed in this series by Reid and Knight (1961). Prior to beginning detailed studies on complexes containing species of medical importance, all species in this poorly known group are being examined.

Material available for study from the Mosquitoes of Middle America (MMA) collection includes approximately 3,600 specimens of which 2,200 are pinned adults, 700 on slides and 700 in alcohol vials. Included in this are approximately 150 individual rearings. Of the currently recognized species in the *Arribalzagaia* Group, 11 are represented in the MMA collection: *apicimacula* Dyar and Knab, *gabaldoni* Vargas, *intermedius* (Peryassú), *mattogrossensis* Lutz and Neiva, *mediopunctatus* (Theobald), *minor* Da Costa Lima, *neomaculipalpus* Curry, *peryassui* Dyar and Knab, *punctimacula* Dyar and Knab, *shannoni* Davis and *vestitipennis* Dyar and Knab. Not all these species are represented in all life stages, and for 3 (*gabaldoni*, *mattogrossensis* and *shannoni*), there are less than 5 specimens.

To date, all the prepared whole larval material of *apicimacula*, most of which is from Panama, has been examined. In addition, most of the whole larvae of *neomaculipalpus* were studied. Preliminary drawings of larval chaetotaxy are being prepared. A start has been made on examination of male genitalia and to date, genitalia of 4 species and the *punctimacula* complex have been studied. It is anticipated that the study of this group can be finished by mid-1978.

(5) Subgenus *Nyssorhynchus*, *Argyritarsis* Group (K. J. Linthicum)

A revision of the *Argyritarsis* Group of the subgenus *Nyssorhynchus* of *Anopheles* was started in the spring of 1974. At present, 8 species are recognized as well as the possible resurrection of 2 synonyms. The species are: *albitarsis* Lynch Arribalzaga, *argyritarsis* Robineau-Desvoidy, *braziliensis* (Chagas), *darlingi* Root, *domesticus* Galvão and Damasceno, *imperfectus* Correa and Ramos, *lanei* Galvão and Amaral, *rooti* Brethes, *pictipennis* (Philippi) and *sawyeri* Causey, Deane, Deane and Sampaio. *Anopheles sawyeri* and *domesticus* have been previously considered as subspecies and both *imperfectus* and *rooti* have been considered as synonyms.

The MMA collection contains about 6,000 specimens of this group of which about 4,400 are pinned adults, 900 are slides (700 larval and pupal and 200 male genitalia) and 700 are in alcohol vials.

Of these, approximately 20% have been individually reared. Of the currently recognized 6 species in the *Argyritarsis* Group, 4 are in the MMA collection and are present in all life stages.

Prior to joining MEP in January 1976, all the larval and pupal specimens of this group had been examined by the investigator in the MMA collection. During a collecting trip to Brazil in the winter of 1975, several of the types present in the collections of the Departamento de Parasitologia, Faculdade de Medicina and the Faculdade de Higiene e Saude Publica, São Paulo were examined.

As of June 30, 1976, a detailed study of all the adult specimens, including male genitalia, present in the MMA collection had been completed. A list of collection records for this material has been compiled. Two type-specimens from the USNM have been studied and work is starting on the examination of 576 specimens from the USNM collection.

Additional material will be studied during the remainder of the year and taxonomic keys for the group will be completed. A detailed literature search covering data on bionomics, distribution and medical significance for each species is in progress. It is anticipated that this revision will be completed by June 1977.

(6) Subgenus *Nyssorhynchus*, *Tarsimaculatus* Group (M. E. Faran)

Research has continued on the revision of the *Tarsimaculatus* Group of the subgenus *Nyssorhynchus* of *Anopheles*. At present, 14 species are recognized in this group with the addition of one other possible new species. These species are: *albimanus* Wiedemann, *anomalophyllus* Komp, *aquasalis* Curry, *benarrochi* Gabaldon, Cova-Garcia and Lopez, *evansae* (Brethes), *galvaoi* Causey, Deane and Deane, *ininii* Senevet and Abonnenc, *noroestensis* Galvão and Lane, *nuneztovari* Gabaldon, *oswaldoi* (Peryassu), *rangeli* Gabaldon, Cova-Garcia and Lopez, *rondoni* (Neiva and Pinto), *sanctielii* Senevet and Abonnenc, and *triannulatus* (Neiva and Pinto).

Topotypic and/or other material has been collected and reared by MMA staff members and cooperators for the *Tarsimaculatus* Group of *Nyssorhynchus*. Locality and ecological data have been recorded on standard collection forms and are on file with the MMA collection. At present the collection contains 10,230 specimens of the *Tarsimaculatus* Group, of which 7,010 are pinned adults, 2,633 slides (2,171 larval and pupal; 366 male genitalia, and 96 adults), and 587 alcoholic vials. Of these 2,384 (23%) have been individually reared. Of the currently valid species of *Tarsimaculatus*, 10 or 71% are present in the MMA collection, and 8 of these are represented in all stages of their life cycle.

For 2 of the more medically important species, *albimanus* and *aquasalis*, abundant individually-reared material is available from almost their entire geographical ranges, permitting a more detailed analysis of population variation within these species and also perhaps correlation of this variation with the vector potential of the individual population.

Zavortink (1973:4), in revising the subgenus *Kerteszia* of *Anopheles*, stated, "The systematics of *Nyssorhynchus* are too poorly known and hopelessly confused." Rozeboom (1942:18) in his guide to the Anopheline mosquitoes of the New World used one couplet in the key for 9 different "species" of *Nyssorhynchus*. The reason for this, as the pioneering work of Komp (1942:25-26) and L. E. Rozeboom recognized, is that the characters that have been used to distinguish the adult females in the *Tarsimaculatus* Group are extremely variable and unreliable for species identification. On the basis of one character alone, it is impossible to reliably identify an adult female to an individual species in this complex, which includes many important vectors of malaria.

The male genitalia have the most reliable characters for species identification; however, nowhere is found complete, detailed illustrations along with keys and descriptions for all the species in the complex. There are also no keys to the pupae for many of the species of the group.

The purpose of the revision of the *"Tarsimaculatus"* Group of the subgenus *Nyssorhynchus* is to attempt to describe and illustrate, in as much detail as possible, all the species in this subgenus and to develop effective keys for all stages of their life cycle that use, particularly for the adult females, more than one character. These keys will hopefully enable a field worker to distinguish, in most cases, a vector species such as *aquasalis*, from a more benign species such as *benarrochi*.

Last fall, the examination of most of the material at the MMA project was completed and further material was borrowed from the USNM. Rough drafts of the keys for larvae, pupae, adults, and male genitalia have been written.

Recently, a review of the literature for the *Tarsimaculatus* Group was completed with the exception of a small number of papers. The number of individual works reviewed total 348 which consisted of journal articles, notes, monographs, proceedings of scientific meetings, and books, Forty-two slides (32 male genitalia, 10 adults) were prepared from the material collected in 1974 by Dr. John F. Reinert in Para, Brazil. Recently a study of the larvae, pupae, and adults of *ininii* was concluded.

Since June 15, rough drafts for the adult female and larval species descriptions have been written. For the duration of the summer it is intended to complete rough drafts for the male genitalia and pupae, and begin writing the bionomics, medical importance and systematic sections of the manuscript

b. Genus *Culex* (S. Sirivanakarn)

Major works on the biosystematics of Oriental *Culex* which have been accomplished during the period include (1) a revision of the genus *Culex*, subgenus *Culex* (42 species) and (2) a revision of the genus *Culex*, subgenus *Lophoceraomyia* (57 species). They were in various stages of preparation as indicated below.

(1) Revision of *Culex (Culex)*. This revision was completed and sent to press in May 1976. It comprises 276 pages including 80 plates of illustrations. No major changes in the context of the original draft were made.

(2) Revision of *Culex (Lophoceraomyia)*. This revision was in final draft in April 1976 and had already been sent to the reviewers. It comprises 360 typed pages and 73 figures. The manuscript is now in final preparation and it is anticipated that it will be ready for publication in the next three or four months.

Other research activities carried out in conjunction with the above studies include:

(1) Identification of some 1,000 *Culex* specimens collected from Sri Lanka by Mr. E. L. Peyton and Dr. Y.-M. Huang. A total of 26 species: 2 *Eumelanomyia*, 7 *Lophoceraomyia* (including 2 new species), 5 *Culiciomyia*, 1 *Lutzia*, 11 *Culex (Culex)* were identified. The 2 new *Lophoceraomyia* species were described with others in the above revision and some new records of *Culex (Culex)* were added to the *Culex (Culex)* manuscript.

(2) In co-authorship with Dr. S. Ramalingam, a short taxonomic paper describing a new species and notes on 3 other species of *Culex (Eumelanomyia)* from Malaysia was prepared for publication in the June 1976 issue of Mosquito Systematics.

(3) Preparation of a manuscript designating a neotype for *Culex (Culex) quinquefasciatus*. The descriptive part has been completed but because of complex nomenclatural problems, it is planned to publish this paper at a later date.

c. Genus *Aedes* (Y.-M. Huang)

A revisionary study of the *w-albus* group of the subgenus *Stegomyia* was completed in May 1975. However, there was a taxonomic problem regarding the true identity of *Ae. mediopunctatus* (Theobald) which remained unresolved. A recent study of newly collected material consisting of the male and pupa of *Ae. mediopunctatus* from Sri Lanka, confirms that *submediopunctatus* (Barraud) is a synonym of *mediopunctatus*. Therefore, some portions of the manuscript were revised where necessary. Further progress made towards the completion of the monograph include preparation of the references cited, table of contents, abstract and introduction.

From June 1975 to June 1976, 23 lots of eggs, 500 adults and 666 vials (unmounted material) of the *Ae. scutellaris* group were received from Vava'u Is., Horne Is., Wallis Is., and Lau Is., in the South Pacific. All of the eggs received from Dr. J. B. Hitchcock (World Health Organization) were hatched at MEP. Progeny rearings were carried out and the adult specimens with associated skins of larvae and pupae were prepared at MEP for taxonomic studies. A total of 58 adults with associated larval and pupal skins and 2 whole 4th instar larvae were obtained. The immature specimens were mounted at MEP for taxonomic studies. All the adult specimens have been examined and identified and 298 terminalia were dissected and prepared on slides.

Pictorial keys to the mosquito vectors of pathogens causing filariasis and/or dengue fever in the South Pacific were prepared. This was a request from the World Health Organization in order to assist field workers, such as public health inspectors and laboratory technicians to recognize the vector species in the area. A total of 19 species (2 *Culex*, 1 *Ae. (Ochlerotatus)*, 4 *Ae. (Finlaya)*, and 12 *Ae. (Stegomyia)* are included in the pictorial keys for both adults and larvae. During the course of this work more than 4,000 specimens from the South Pacific were examined.

The taxonomic study of the *Ae. scutellaris* group of the South Pacific was concentrated mainly on the Tonga Islands. All the adults from the Tonga area have been examined which include the preparation of male and female terminalia. Eighty percent of the immature stages from the Tonga area have been examined.

Five hundred and eighty-five adult specimens of *Stegomyia* have been examined and identified from the Sri Lanka field trip. A new species of the *scutellaris* group was found and a paper dealing with this new species was published (Huang 1975). During the course of this study, 475 specimens, both adult and immature stages, were examined and 49 male and female terminalia were dissected and prepared on slides.

In addition, 237 specimens have been identified from June 1975 to June 1976 as following:

a. 178 specimens of *Stegomyia* from Andaman and Nicobar Is., Cook Is., Guam, Indonesia and West Malaysia have been identified for Mr. N. L. Kalra, India; Dr. R. W. Gwatz, NIH: Dr. Y. Wada, Japan and CPT R. G. Andre, Malaysia.

b. 59 specimens of *Aedes* (not including *Stegomyia*) and *Culex* from the South Pacific have been identified for Dr. J. B. Hitchcock.

d. Genus *Uranotaenia* (E. L. Peyton)

A draft manuscript (except introduction) on this very complex group of mosquitoes was completed. Four hundred pages are presently typed in draft format. The 76 illustrations to be included in the final monograph have been corrected and numbered. The manuscript includes: a separate discussion and description of 5 natural groups represented in the Oriental region, with the assignment of several extralimital species to each; a complete descriptive treatment of all known life stages; a brief discussion of the type or type-series, its repository and general condition and, where appropriate, lectotypes or neotypes are designated; a full listing of all locality records based on actual examination of specimens and the number of specimens from each locality, and a brief discussion of recorded localities not confirmed by an examination of specimens; a discussion of similarities of various stages with other species and significant variations within or between populations; and a general discussion on the bionomics of each species. It is anticipated that the completed manuscript will be sent to reviewers in September 1976.

The study of the *Uranotaenia* has made significant contributions to the systematics of the genus worldwide. Several important articles were published during the course of the study. The most notable of these was the worldwide review of the genus with the subgeneric classification and the recognition of other supraspecific categories for the first time. Other publications appearing during the course of the *Uranotaenia* study and the present completed manuscript have contributed the following additions or changes to the genus: (1) division of the genus into 2 subgenera; (2) division of the subgenus *Pseudoficalbia* into 2 major subdivisions treated as Sections; (3) subdivision of the 2 Sections into 6 groups treated as series; (4) placement of 10 species in synonymy; (5) revalidation of 2 species; (6) description of 24 new species; (7) selection of 7 lectotypes; (8) selection of 2 neotypes; (9) illustration of 24 male terminalia, 22 larvae and 22 pupae for the first time.

In addition to the above study on the *Uranotaenia*, this investigator participated in a field collecting and training trip to Pakistan and Sri Lanka from 6 June to 25 August 1975. Upon completion of the trip considerable time was devoted to sorting and identification of all the *Uranotaenia* and *Anopheles* collected, and the preparation of reports required by the sponsoring agency. A detailed report of the Sri Lanka-Pakistan trip is presented in section 1.e. of this report.

e. Mosquitoes of Sri Lanka and Pakistan (E. L. Peyton and Y.-M. Huang)

Dr. Y.-M. Huang and Mr. E. L. Peyton spent 60 days in Sri Lanka from 19 June to 17 August 1975. Travel and overseas per diem expenses were borne by the Smithsonian Foreign Currency program. Except for a few days spent in Colombo at the beginning and end of the trip, all time was devoted to collecting mosquitoes under a wide variety of ecological conditions on the island.

The MEP team collected mosquitoes in the following areas: Kandy-Peradeniya; Matale; Nuwara Eliya; Kaneliya (Sinharaja Forest); Galle; Agalawatta; Morapitiya Udagalla (Sinharaja Forest); Kalatuwawa, Labugama; Wilpatu, Kala-Oya. The goal was to collect topotypic specimens and representatives of as many of the other reported species as possible. All efforts were concentrated on the collection of immatures in the natural habitat and carrying out individual rearings for the recovery of a series of adults with associated immature skins for each species collected. Consequently, the collections were highly selective and no single type habitat was favored. Both forested and open areas were sampled. The southern and central rain forest and open areas were sampled. The southern and central rain forest and peripheral areas received the most attention due to the particular season which provided the widest variety of habitat and species. Due to the specialized nature of the collections made, considerable detailed ecological information was accumulated. This was perhaps the most significant aspect of the expedition since most of the earlier studies were based principally upon the adult stage and many of the immature stages of long established species were undescribed. With the exception of 2 or 3 species, a good series of all life stages (male, female, larva and pupa) were obtained for each species collected. Such collections are considered essential for a comprehensive treatment of the island mosquito fauna. It is anticipated that this collection will form the nucleus for a future monograph on the mosquitoes of Sri Lanka. There is no single taxonomic reference to the island fauna except for a checklist published in 1950. Four articles based on specimens collected by the Smithsonian Insect Project have been published by the Medical Entomology Project. One enumerated 64 taxa collected during 4 years of field work by Smithsonian teams. The others described new species in *Anopheles*, *Uranotaenia* and *Aedes*.

A number of new country records, previously undescribed stages (males and immatures), and new species were collected. It is anticipated that several papers will result from this trip after each specialist of the Medical Entomology Project examines the specimens in greater detail. This will require the study of slide preparations of approximately 8,000 male terminalia, larval and pupal skins and whole fourth stage larvae. The preparation of this material was completed in June 1976.

Some of the more significant findings to date are as follows: A new species of the *Aedes scutellaris* group was commonly found in the Kandy-Kaneliya area (*Ae. krombeini* Huang 1975). The species had been doubtfully recorded earlier as *Ae. scutellaris* (Walker) and apparently frequently mis-identified as *Ae. albopictus* (Skuse) which is also common throughout much of the island. The 2 were collected several times from the same habitat. Members of the *Ae. scutellaris* group are known to be involved in the transmission of dengue viruses and filariasis in other areas of the Oriental region. In view of this, the Sri Lanka species bears closer scrutiny in relation to the routine surveys for *albopictus* being conducted on the island. Several collections of a species of the *An. leucosphyrus* group were collected in the southern hill country. All now appear to be *elegans* (James) but several specimens vary somewhat from typical *elegans*. The immature stages of this species are undescribed. This species is very close to *An. balabacensis* Baisas, which has been reported from the southwest coast of India. There is a vague reference to *balabacensis* in Sri Lanka by Reid (1968), without specific locality or reference to specimen or specimens examined. A very large series with associated immature stages was obtained and a future detailed study of these should clarify the identity of the Sri Lanka species.

An apparently new species of the genus *Topomyia* was collected in the Kalatuwawa area. This is the first record of the genus for Sri Lanka.

Uranotaenia bicolor Leicester and *obscura* Edwards were found commonly in the southern forest. Both species are known from India but never before reported from Sri Lanka.

In addition to the above, several topotypic specimens were collected. A topotypic collection of *Ae. (Stegomyia) mediopunctatus* Theobald will help to clarify the identity of specimens under that name from India. Previous to this collection, the male was unknown for the typical species (positive identification for many *Ae. (Stegomyia)* species is based on the male terminalia). A large series of the endemic *Ur. (Uranotaenia) rutherfordi* Edwards was

obtained. The species had been viewed as rare, having been described in 1922. It is apparently represented in the major museums by less than a half dozen adult specimens. The immature stages are undescribed.

It is now apparent that prior to the efforts of the Smithsonian Ceylon Insect Project, the mosquito fauna of Sri Lanka was very incompletely known. Over the past 5 years this project has made significant contributions in this regard.

Prior to the arrival in Sri Lanka, the MEP team spent 10 days in Pakistan with members of the University of Maryland International Center for Medical Research and Training (ICMRT) at the Pakistan Medical Research Center in Lahore. Several meetings were held with Dr. R. H. Baker, Director of the ICMRT program and Dr. M. Aslamkhan, Associate Professor of International Medicine reviewing mosquito problems in Pakistan and possible collaborative efforts for a taxonomic study of Pakistan mosquitoes. The MEP team observed the research being conducted by the ICMRT on mosquito genetics and accompanied staff members to collect mosquitoes in the field around Lahore. At the *Anopheles* collecting and study site it was noted that almost unbelievable numbers of day-resting *An. culicifacies* Giles, the principal vector of malaria in Pakistan, were encountered in mud-thatched houses. Dr. Baker permitted a team with vehicle to accompany Mr. Peyton and Dr. Huang for 4 days collecting in the northern area of Rawalpindi. The team made several interesting collections at the 5,000 - 7,000' level north of Rawalpindi. The season was the driest part of the year and the 4 days were much too short to accomplish any meaningful collections for rearing. However, the stay was worthwhile in the experience gained and in the establishment of good contacts in the country for possible future work.

2. Curatorial Activities

a. Status of world collection of Culicidae

With the completion of research on certain groups of Oriental mosquitoes, portions of the collection were rearranged in systematic order by Mr. T. V. Gaffigan. This process will continue during the coming year as additional monographs are published.

A number of requests for material from the world collection were handled by staff personnel. Most notable among these were the North American *Aedes* for Dr. D. M. Wood who is preparing a manual on Canadian mosquitoes and the Neotropical *Anopheles* for Dr. J. N. Belkin's graduate students.

Arrangements were made by Dr. John N. Belkin (University of California, Los Angeles) for the transfer of a portion of his collection to the USNM under the auspices of MEP. This was expedited through the placement of the former collections manager of the Mosquitoes of Middle America project, Mr. W. A. Powder on the MEP staff for a 3 month period from 10 March to 10 June as a museum specialist. In this capacity, Mr. Powder had the responsibility for the preparation and shipping of a portion of the Belkin collection to Washington and subsequent unpacking and arrangement of the collection in Hall 27 of the Natural History Building.

The following segments of the Belkin collection were received by the USNM in June 1976:

1. Old World collection - Specimens used for "The Mosquitoes of the South Pacific" (Belkin 1962), "The Culicidae of New Zealand" (Belkin 1968) miscellaneous Old World material: 44,485 adults, 18,920 slide preparations (immature stages, male terminalia) and 4,280 vials of alcoholic specimens.

2. New World collection - *Culex (melanoconion)* (in part), *Haemagogus (Haemagogus)*, *Aedes (Ochlerotatus) varipalpus* group and *Aedes (Protomacleaya)*: 22,269 adults, 13,162 slides and 3,342 vials.

The above specimens are stored in 8 insect cases containing 192 Cornell drawers and 396 microscope slide boxes which will be an integral portion of the Belkin donation to the Smithsonian Institution. The South Pacific material also contains a file cabinet containing collection records, notes and ledgers dating back to World War II.

b. Accessions and other activities of the MEP Collections Management Section

The 98 accessions received by MEP are summarized in Appendix 2. During 1975-76, these totaled more than 34,000 specimens. The Sri Lanka specimens collected by MEP staff members represented the most important accession (13,462 specimens) followed by accessions from the SEATO Medical Research Laboratory (4,431) and the Bishop Museum (1,993) respectively. Outgoing material for this period (loans, return of borrowed specimens and type depositions) totaled 8,670 specimens (4,048 adults, 4,389 slides and 233 vials of unmounted immatures).

3. Other Activities

a. Identification services

The project continued to perform routine identification services for the U. S. Department of Agriculture as in the previous year. Fifteen of the 98 lots of specimens received by MEP fell into this category. Within the Department of Defense, mosquitoes were identified for various Army and Air Force medical units from Guam, the Philippines, Thailand, Brazil and the U. S. One of the more interesting lots received contained specimens of 2 unrecorded species of *Anopheles* from Guam (*An. barbirostris* group and *An. litoralis* King). Other material was identified for the Agency for International Development, Department of the Interior, University of California Arbovirus Research Unit in Malaysia, Johns Hopkins University Institute for Medical Research and Training in Bangladesh, University of Maryland Pakistan Medical Center in Pakistan and the Teiko University School of Medicine in Japan.

b. Publications

Nine papers were published under the auspices of the project during the year (Appendix 3). Two of these were major reviews in the "Medical entomology studies" series (Harrison and Scanlon 1975; Reinert 1976), while the remaining papers were published in journals other than the "Contributions of the American Entomological Institute." Final drafts of monographs on the subgenus *Culex* of the Oriental region and the immature Tabanidae of Arizona by Drs. S. Sirivanakarn and J. F. Burger respectively, were accepted for publication during the coming year.

c. Training

Several days were spent with CPT J. Abercrombie and technicians from the U. S. Army Environmental Hygiene Agency (Regional Division North), Fort Meade, Maryland demonstrating procedures for rearing and processing mosquito specimens for taxonomic study. It is anticipated that these military technicians will be able to provide specimens of the type required for modern systematic study.

Mr. E. L. Peyton has been invited to visit the U. S. Army Medical Research Unit laboratory in Belem, Brazil during September and October 1976 for the purpose of training their entomologists and Brazilian technicians in field collecting and rearing procedures, slide and specimen preparation and identification methodology.

d. Illustrations

The scientific illustrators prepared almost 500 inked drawings during the year. The following illustrations were completed: larvae - 148, pupae - 37, male terminalia - 63, female terminalia - 9, adult habitus (parts) - 226, and 6 distribution maps and table. In addition, 172 drawings had been completed in pencil, in preparation for final checking before being inked. Corrections and modifications were made to 164 previously prepared plates. Photographs of immature stages of 26 species of Tabanidae were assembled and mounted on 8 plates for Dr. J. Burger's monograph. Chaetotaxy counts were made from 125 specimens of larval and pupal mosquitoes for use on 20 plates.

As time became available, the illustrators prepared plates for the collaborators. Among such plates prepared were those of the immature stages of the *Anopheles gambiae* complex for Dr. G. B. White, the undescribed larva and pupa of *An. aruni* Sobti for Dr. B. de Meillon and *Armigeres* larvae, pupae and male terminalia for Dr. S. Ramalingam.

Mr. Vichai Malikul participated in the teaching program of the summer workshop in Natural Sciences Illustration in the U. S. Department of Agriculture Graduate School and presented a lecture demonstration of the wash technique used in mosquito habitus illustration in July 1975.

Plates completed during the past year will be exhibited by staff illustrators at the XVth International Congress of Entomology during August 1976.

e. Scientific literature

Further progress has been made in integrating the U. S. Department of Agriculture mosquito literature file with that of MEP. An attempt is being made to retain 2 copies of all papers on mosquito biosystematics. Duplicate papers (in excess of the above) are being sent to the Military Entomology Information Service (MEIS) of the Armed Forces Pest Control Board for retention in their files.

Additional references on the original descriptions of Culicidae have been furnished to Dr. K. L. Knight for the bibliography section of the revised world catalog of mosquitoes.

Copies of approximately 80 papers on anophelines were lent to Dr. J. B. Kitzmiller who is preparing a historical account on the derivation of the specific names of anopheline mosquitoes.

f. Indian and African field studies

Mr. B. N. Mohan, of Coonoor, India, collected a large number of specimens from the Nilgiri Hills region which were sent to MEP during the year (Appendix 2). A special effort has been made by Mr. Mohan to collect specimens of the *Anopheles leucosphyrus* group. Smaller collections were received from South Africa (Mr. J. Muspratt) and Kenya (Dr. P. L. Lounibos).

g. Participation in scientific activities

Dr. Y.-M. Huang attended the joint meetings of the Northeastern Mosquito Control Association and the American Mosquito Control Association in Boston, Massachusetts from 20 - 23 April 1976.

From 25 April - 7 May 1976, Dr. S. Sirivanakarn visited the Department of Biology, University of California, Los Angeles to consult with Dr. John N. Belkin and other staff members of the Mosquitoes of Middle America project on some aspects of a planned revisionary study of the New World *Culex* subgenus *Melanoconion*.

Dr. R. A. Ward attended the annual meeting of the Entomological Society of America in New Orleans, Louisiana from 30 November - 4 December 1975 (at no expense to MEP). While there, he presented a symposium on "Overseas Research Activities in Medical and Veterinary Entomology." During the year, Dr. Ward was appointed to the editorial boards of the "Annals of the Entomological Society of America" and "Mosquito News."

Mr. V. Malikul participated in the teaching program of a summer workshop in Natural Science Illustration in the U. S. Department of Agriculture Graduate School during July 1975.

h. Visitors

During the year, more than 40 entomologists visited the project. These included individuals from other federal agencies, military entomologists, universities and museums. Visitors from overseas included CPT R. G. Andre (U. S. Army Component, SEATO, Thailand), Dr. W. Z. Coker (University of Ghana), Dr. Pedro Galindo (Gorgas Memorial Laboratory, Panama), Dr. J. C. Hitchcock (World Health Organization, Switzerland), CPT A. L. Hoch, MAJ D. R. Roberts and Mr. N. Peterson (USAMRU - Transamazon, Brazil), Mr. N. L. Kalra (National Institute of Communicable Disease, India), Dr. L. P. Lounibos (Mosquito Biology Unit, Kenya), Dr. J. Margalit (The Hebrew University, Israel), Dr. P. F. Mattingly and Dr. G. B. White (British Museum ((Natural History)) England), Dr. D. J. Pletsch (Mexico), Dr. K. Tanaka (U. S. Army Medical Laboratory - Pacific, Japan) and Dr. Y. Wada (Nagasaki University School of Medicine, Japan).

Some of the above entomologists spent periods of several days to three weeks at MEP. These included Dr. G. B. White (African mosquitoes), Dr. P. F. Mattingly (genus *Tripteroides)*, Mr. N. L. Kalra (mosquitoes of the Andaman Islands) and Dr. K. Tanaka (mosquitoes of Japan and Korea).

Dr. W. E. Bickley (University of Maryland) studied the Alaskan mosquito collection at MEP during a six-month sabbatical period. He was able to clarify a number of details concerning the distribution and identification of Alaskan mosquitoes. A manuscript on his work is being prepared.

i. Consultants

Several new individuals were added to the list of consultants to the project on the basis of interest in African and New World Culicidae (Appendix 4). Drs. Mattingly and Ramalingam are actively conducting revisionary studies on the genera *Tripteroides* and *Armigeres* respectively. Manuscript reviews of major works have been provided by Drs. de Meillon, Belkin, Gould and Mattingly during the past year. In addition, other medical entomologists, although not on the MEP roster of consultants, have provided prepublication reviews. These include Drs. L. L. Pechuman and H. J. Tesky for a Tabanidae monograph and Drs. D. H. Colless, B. F. Eldridge, W. A. Steffan and J. A. Tenorio for Culicidae papers.

4. Discussion and Recommendations

The past year has been devoted towards the completion of several revisions of mosquitoes of Southeast Asia which had been in progress for a number of years. Whenever possible, the scope of these monographs was broadened to cover the Oriental region as a whole to increase the utility of the work.

As these studies were terminated, the resources of the project were directed towards providing biosystematic support for the U. S. Army Medical Research Unit in Belem, Brazil. The major emphasis to date has consisted of conducting research on the *Arribalzagaia* group of the subgenus *Anopheles* and the *Tarsimaculatus* and *Argyritarsis* groups of the subgenus *Nyssorhynchus;* all of which contain important malaria vectors.

In previous years, MEP and its predecessor SEAMP (Southeast Asia Mosquito Project), had the advantage of large collections built up over a long period of time by the SEATO Medical Research Laboratory and the Mosquitoes of Malaya Project (Dr. S. Ramalingam) to use as basic resources for comprehensive studies.

While making protocols for future MEP activities, it became evident that such large-scale assemblages of material as the above would not be available for future work, with the exception of the John N. Belkin Collection of Middle American Mosquitoes. Consequently, a limited program was developed using collaborators in various areas of the world for the collection and preservation of mosquito specimens for biosystematic study. These collaborators were given small sums to cover their field and collecting expenses. On the whole, with a single exception (Mr. B. N. Mohan in India), this program has not been as successful as anticipated. Consequently, the program has been eliminated from current activities with the exception of a small continuation with Mr. B. N. Mohan.

The great success of the Sri Lanka field trip serves to emphasize that the most efficient method of securing a large amount of perfect material is to use staff personnel for this task. However, it should be noted, that between the time actually spent in the field and making preparations for the trip, 2 professional staff members devoted 4 months each to this activity. In addition, considerable time was used by supportive staff in making arrangements for the trip, procuring supplies, etc.

A practical alternative to the above, appears to be one in which a highly skilled taxonomist will be sent to a field situation to train a local team in proper techniques and leave them under the supervision of a competent medical entomologist who will see that these procedures will be implemented in the future. This approach will be followed during the coming contract year when Mr. E. L. Peyton will go to Brazil to work with the U. S. Army Medical Research Unit for a sixty-day period.

Appendix 1

PERSONNEL RECEIVING CONTRACT SUPPORT

Name	Date of Service	Organization
Current Staff:		
*Bryce, George K.	03-28-76	SI
Chang, Suzan Chien E.	06-01-74	SI
Dery, Ann L. Hoskins	06-01-74	SI
*Faran, Michael E.	03-28-76	SI
Ford, Virginia M.	06-01-74	SI
Gaffigan, Thomas V.	06-01-74	SI
*Huang, Dr. Yiau-Min	06-01-74	SI
*Linthicum, Kenneth J.	01-26-76	SI
Malikul, Vichai	06-01-74	SI
Paige, Ellen M.	06-01-74	SI
*Peyton, E. L.	06-01-74	SI
Rupp, Janet D.	06-01-74	SI
Schiff, Lotte B.	06-01-74	SI
*Sirivanakarn, Dr. Sunthorn	06-01-74	SI
Smallwood, Penelope B.	06-01-74	SI
Smith, Thelma F.	06-01-74	SI
Sohn, Young T.	06-01-74	SI
Spangler, Phyllis	06-01-74	SI
Utmar, Joyce A.	06-01-74	SI
*Ward, Dr. Ronald A.	06-01-74	WRAIR
Staff Separated:		
Buescher, Michael D.	09-28-75 - 05-14-76	SI
*Burger, Dr. John F.	01-27-75 - 08-31-75	SI
Bosma, Julia M.	10-14-75 - 06-30-76	SI
Curtis, Owilda J. R.	06-01-74 - 06-30-76	SI
Gordon, Gloria E.	06-01-74 - 06-30-76	SI
Manion, Ann G.	03-08-76 - 06-30-76	SI
Markowitz, Norman	06-01-75 - 05-22-76	SI
Powder, William A.	03-10-76 - 06-10-76	SI
Starcke, Helle	06-01-74 - 06-30-76	SI
White, Lawrence, Jr.	06-01-74 - 06-30-76	SI

* Entomologist

Appendix 2.

ACCESSIONS OF THE MEDICAL ENTOMOLOGY PROJECT, 1975-76

Source	Number of Accessions	Adults	Slides	Other
Systematic Entomology Laboratory, U. S. Department of Agriculture, Washington, D. C.	15	32	0	26 unmtd. imm.
U. S. Navy Regional Medical Center, Guam	8	545	10	268 unmtd. imm.
World Health Organization, Tonga	6	488	0	23 egg lots 1,115 unmtd. imm.
SEATO Medical Research Laboratory, Bangkok, Thailand	5	1,836	2,586	9 unmtd. imm.
Department of Biology, University of California, Los Angeles, CA	5	1,771	714	2 unmtd. imm.
British Museum (Natural History), London, England	5	38	46	0
University of Nagasaki School of Medicine, Nagasaki, Japan	3	360	0	312 unmtd. imm.
London School of Hygiene and Tropical Medicine, London, England	3	19	0	24 unmtd. imm.
International Center for Medical Research, Johns Hopkins University, Dacca, Bangladesh	2	429	0	248 unmtd. imm.
Dr. D. H. Pletsch, Mexico, D. F. Mexico	2	258	0	8 unmtd. imm.
Mosquito Biology Unit, Mombasa, Kenya	2	171	0	33 unmtd. imm.
U. S. Army Medical Laboratory - Pacific, Tokyo, Japan	2	71	46	3 unmtd. imm.
University of Malaya, Kuala Lumpur, Malaysia	2	33	33	0
U. S. Army Medical Research Unit (Trans-Amazon), Belem, Brazil	2	959	0	788 unmtd. imm.

Source	Number of Accessions	Adults	Slides	Other
Bishop Museum, Honolulu, HI	2	1,937	56	0
International Center for Medical Research and Training, University of Maryland, Lahore, Pakistan	3	256	0	153 unmtd. imm.
Mr. B. N. Mohan, Coonoor, India	2	1,172	0	615 unmtd. imm.
Siegfried Annecke Institute, Tzaneen, South Africa	2	6	0	8 unmtd. imm.
U. S. National Museum (Expeditions), Washington, D. C.	2	350	0	63 unmtd. imm.
U. S. Air Force - Pacific, Clark Air Force Base, Philippines	1	45	0	0
University of California, Davis, CA	1	22	11	0
University of Ryukyus, Okinawa, Japan	1	5	2	0
Caribbean Epidemiological Center, Port of Spain, Trinidad	1	0	0	22 unmtd. imm.
Mr. Ray Collins, United Nations Developmental Program, Djakarta, Indonesia	1	11	0	26 unmtd. imm.
U. S. Air Force Aerospace Medical Center, Brooks Air Force Base, TX	1	16	0	0
National Institute of Communicable Disease, Delhi, India	1	5	0	0
World Health Organization, Kabul, Afghanistan	1	0	0	5 unmtd. imm.
Department of Environmental Resources, Harrisburg, PA	1	0	0	5 unmtd. imm.
University of Maryland, College Park, MD	1	34	1	0
U. S. Army Medical Research Unit, Kuala Lumpur, Malaysia	1	238	114	0
Medical Entomology Project Field Trip to Sri Lanka	1	5,057	0	8,405 unmtd. imm.

Source	Number of Accessions	Adults	Slides	Other
Field Museum of Natural History, Chicago, IL	1	0	0	660 unmtd. ad.
Mr. J. Muspratt, South Africa	1	234	0	78 unmtd. imm.
Taiwan Provincial Institute of Infectious Diseases, Taipai, Taiwan	1	61	48	0
Center for Disease Control, Atlanta, GA	1	63	77	0
5th Preventive Medicine Unit, Korea	1	0	0	30 unmtd. imm.
South African Institute for Medical Research, Johannesburg, South Africa	1	112	0	72 unmtd. imm.
Medical Research Institute, Colombo, Sri Lanka	1	48	0	0
Walter Reed Army Institute of Research, Washington, D. C.	1	21	0	22 unmtd. imm.
Waterloo University, Ontario, Canada	1	0	0	20 unmtd. ad. 2 unmtd. imm.
Armed Forces Institute of Pathology, Washington, D. C.	1	0	157	0
U. S. Army Medical Laboratory, West Germany	1	371	0	0
National Institutes of Health, Bethesda, MD	1	0	0	10 unmtd. imm.
Korean National Institutes of Health, Seoul, Korea	1	25	0	0

Summary of Accessions From 1 June 1975 To 30 June 1976

98 accessions, including 23 lots of eggs for rearing

680 unmounted adults
12,352 unmounted immatures
3,901 slides
17,099 adults

34,032 total specimens

Appendix 3

PUBLICATIONS OF THE MEDICAL ENTOMOLOGY PROJECT

Harrison, B. A., and J. E. Scanlon. 1975. Medical entomology studies - II. The subgenus *Anopheles* in Thailand (Diptera: Culicidae). Contr. Am. Entomol. Inst. 12(1): 1-307. (December)

Huang, Y.-M. 1975. A new species of *Aedes (Stegomyia)* from Sri Lanka (Ceylon) (Diptera: Culicidae). Mosq. Syst. 7(4): 345-356. (December)

Sirivanakarn, S. 1975. A new species of *Culex (Eumelanomyia)* Theobald from Manus Island, Papua-New Guinea (Diptera: Culicidae). Mosq. Syst. 7(4): 394-400. (December)

Floore, T. G., B. A. Harrison and B. F. Eldridge. 1976. The *Anopheles (Anopheles) Crucians* subgroup in the United States (Diptera: Culicidae). Mosq. Syst. 8(1): 1-110. (March)

Ward, R. A., B. Jordan, A. R. Gillogly and F. J. Harrison. 1976. *Anopheles Litoralis* King and *A. Barbirostris* group on the Island of Guam. Mosq. News 36(1): 99-100. (March)

Reinert, J. F. 1976. Medical entomology studies - IV. The subgenera *Indusius* and *Edwardsaedes* of the genus *Aedes* (Diptera: Culicidae). Contr. Am. Entomol. Inst. 13(1): 1-45. (May)

_____. 1976. A ventromedian cervical sclerite of mosquito larvae (Diptera: Culicidae). Mosq. Syst. 8(2): 205-208. (June)

Sirivanakarn, S. and S. Ramalingam. 1976. A new species of *Culex (Eumelanomyia)* Theobald with notes on three other species from Malaysia (Diptera: Culicidae). Mosq. Syst. 8(2): 209-216. (June)

Utmar, J. A. and W. W. Wirth. 1976. A revision of the New World species of *Forcipomyia*, subgenus *Caloforcipomyia* (Diptera: Ceratopogonidae). Florida Entomologist. 59(2): 109-133. (June)

Appendix 4

MEDICAL ENTOMOLOGY PROJECT CONSULTANTS

Dr. John N. Belkin, University of California, Los Angeles, California - New World Culicidae.

Dr. Pedro Galindo, Gorgas Memorial Laboratory, P. O. Box 2016, Balboa Heights, Canal Zone - New World Culicidae.

Dr. Douglas J. Gould, SEATO Medical Research Laboratory, Bangkok, Thailand - Culicidae of Thailand.

MAJ Bruce A. Harrison, North Carolina State University, Raleigh, North Carolina - Oriental *Anopheles*.

Dr. James B. Hitchcock, Jr., Malaria and Parasitic Diseases, World Health Organization, Geneva, Switzerland - Pacific Culicidae.

Dr. Botha de Meillon, Philadelphia, Pennsylvania - Culicidae of Africa and Southeast Asia.

Dr. J. M. Klein, ORSTOM, Bondy, France - Oriental Culicidae.

Professor Kenneth L. Knight, North Carolina State University, Raleigh, North Carolina - *Aedes (Finlaya)* and mosquito glossary.

Dr. Peter F. Mattingly, British Museum (Natural History), London, England - African Culicidae and *Tripteroides*.

Dr. J. Rageau, ORSTOM, Bondy, France - Culicidae.

Dr. Shivaji Ramalingam, University of Malaya, Kuala Lumpur, Malaysia - *Topomyia, Malaya, Armigeres* and Malaysian Culicidae.

Dr. Graham B. White, British Museum (Natural History), London, England - African Culicidae.

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